

NEW RECORDS OF EPHEMEROPTERA IN UTAH, WITH NOTES ON BIOGEOGRAPHY¹

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ABSTRACT: Two species of mayflies, *Baetis flavistriga* (family Baetidae) and *Choroterpes inornata* (family Leptophlebiidae) are reported from Utah for the first time. Records are from Capitol Reef National Park and represent known range limits for these species. Evidently neither species has penetrated the Great Basin proper. Notes on distribution, aquatic habitat, and life history of both species are provided.

Utah is one of the best known regions in North America with respect to its mayfly fauna. The major reason for this is simple: It is the home state and residence of George F. Edmunds, Jr., one of the world's most noted and productive Ephemeroptera researchers. Edmunds has collected and studied mayflies in the state since the 1940's, and Edmunds' Ph.D. dissertation was in part a faunistic study of the mayflies of Utah (Edmunds 1952). The only faunal list that has appeared for the entire state was provided by Edmunds (1954), wherein 62 nominal species were documented. Other records and synonymies since 1954 bring the current state total to approximately 70.

One of us (JFM) recently collected aquatic insects from the Capitol Reef area in south-central Utah. Ephemeroptera collected from Pleasant Creek, at about 1,900m elevation, within Capitol Reef National Park, consisted of *Acentrella insignificans* (McDunnough), *Baetis flavistriga* McDunnough, *B. tricaudatus* Dodds, *Choroterpes inornata* Eaton, *Hep- tagenia solitaria* McDunnough, *Paraleptophlebia debilis* (Walker), *Rhithrogena morrisoni* (Banks), and *Tricorythodes minutus* Traver. *Baetis flavistriga* and *C. inornata* represent new records for the state. The new records are significant because the state's mayfly fauna is relatively well known and because this locale may be near the range limit of both species. The new records and notes on these newly found species follow.

Baetis flavistriga McDunnough

New Records. Thirty three larvae, Utah, Wayne Co., Pleasant Creek, Capitol Reef National Park, upstream from Sleeping Rainbow Ranch, VIII-3-1993, J. F. MacDonald, deposited in the Purdue Entomological Research Collection (PERC); 60 larvae and one male adult, Utah, Wayne Co., Capitol Reef National Park, downstream from Sleeping Rainbow Ranch, VIII-4-5-1993, J. F. MacDonald, deposited in PERC.

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McCafferty *et al.* (1993) in their inventory of the Colorado mayflies, discussed the distribution of *B. flavistriga*. This species demonstrates an unusual mayfly distribution pattern in that it is transcontinental but mainly distributed in mountain ranges. Except for being generally common in the Great Lakes region in the Midwest (Moriyama and McCafferty 1979), it is known primarily from the Appalachians in the East (Moriyama and McCafferty 1979), the Ozark-Ouachitas (McCafferty and Provonsha 1978), the Black Hills of South Dakota (McCafferty 1990), and the Colorado Rockies (McCafferty *et al.* 1993). The Utah record may prove, however, to be very near its western range limit.

The Capitol Reef area, while considered part of the Great Basin Province in terms of its flora (Gleason and Cronquist 1964), represents an area that differs physiographically from most of the Great Basin (to the west and northwest) in that it has a sea drainage via the Colorado River system. The Great Basin proper drains to the interior, lacking a sea drainage. This may account for the current absence of some western aquatic species in the Great Basin: Dendritic drainage routes connecting the Great Basin proper with exterior drainage systems are essentially lacking [a few minor connections via diversions across divides for irrigation purposes have occurred in the last century (Hubbs and Miller 1948)], and such routes are necessary for dispersal of some lotic aquatic insects (see e.g., Ross 1967, Ross *et al.* 1967, Flannagan and Flannagan 1982) just as they are for freshwater fishes in general (see e.g., Miller 1958, Page 1983, Smith 1983). Western aquatic insects, many of which can be assumed to have been present in the Great Basin during recent Pluvial periods, may not have been able to colonize (or recolonize) the Great Basin since the drying of basin lakes and stream connectors some 7,500 to 2,500 years ago (Blackwelder 1948). Such dispersal via drainages would appear especially pertinent in arid regions of the western United States, where considerable overland distances occur between streams and thus can preclude overland flight dispersal by many aquatic insects. We consider many aquatic insects now present in the Great Basin to be Pluvial relicts, much as the Great Basin fishes (Hubbs and Miller 1948). Given its restricted Colorado drainage distribution in Utah, its continental distribution east of Utah, and its apparent absence from northwestern Pacific drainage systems, we hypothesize that *B. flavistriga* has not colonized the Great Basin either in Pluvial or Postpluvial periods.

Moriyama and McCafferty (1979) indicated that larvae of *B. flavistriga* generally inhabit rocky substrates of streams. Bergman and Hilsenhoff (1978) found populations in Wisconsin to be either univoltine with a prolonged hatching period in the summer, or bivoltine with overlapping

cohorts. Samples from Utah were taken from Pleasant Creek where it is relatively clean and cold, devoid of canopy, and ranging from approximately 1.5 to 3.0m in width and 15.0 to 45.0cm in depth. The current is essentially erosional, and substrate is mixed, being primarily made up of pebble, cobble, and some boulders with moderate periphyton growth. *Baetis flavistriga* larvae were taken on substrates of coarse gravel, pebble, cobble, and boulders. Larval samples consisted of both fully mature individuals, with dark wingpads, and individuals of the same size, but without dark wingpads, and presumably nearly mature. Emergence appeared imminent, and although collecting emphasis with regard to mayflies was on benthic forms, one confirmed adult was taken, and numerous subimagos of *Baetis* that may have been this species were taken in Malaise traps positioned along the stream.

Choroterpes inornata Eaton

New records. Three larvae, Utah, Wayne Co., Capitol Reef National Park, downstream from Sleeping Rainbow Ranch, VIII-5-1993, J. F. MacDonald deposited in PERC.

Allen (1974) provided a range map of this southwestern species, which included records from Sonora, Mexico, southeastern Arizona, western and northern New Mexico, and southern Colorado. McCafferty *et al.* (1993) confirmed its existence in much of western and northwestern Colorado. Mesa Co., Colorado, on the Utah border, is the nearest record to the Utah site. Capitol Reef may be near the westernmost distribution north of Arizona. As is the case for *B. flavistriga* (see discussion above), we hypothesize that *C. inornata* has not colonized the Great Basin proper.

McCafferty *et al.* (1993) considered *C. inornata* among species they called the western sand/silt riverine fauna. This faunal group includes western slope/plateau species in Colorado (see McCafferty *et al.* 1993) that range from Mexico, Arizona, or New Mexico usually to southwestern Wyoming, and sometimes as far north as Saskatchewan. Their dispersal evidently has been via sand/silt bottomed rivers of the Colorado River drainage and the Colorado Plateau such as the Green River and its tributaries in Utah and Wyoming. Edmunds (pers. comm.) has unreported sightings of *C. inornata* in other Colorado drainage system areas in northeastern Utah. These sightings would be predictable if the above conclusions regarding the distribution of this species are correct.

DISCUSSION

Of the other nominal mayfly species taken at Pleasant Creek in

Capitol Reef National Park (see above), *Heptagenia solitaria* was also considered a member of the western sand/silt riverine fauna by McCafferty *et al.* (1993). The identification of *Rhithrogena morrisoni* from Capitol Reef is tentative because it is based on larvae that are very difficult to distinguish from *R. hageni* Eaton and *R. undulata* (Banks) larvae. *Rhithrogena morrisoni* has not been taken commonly from the western slope/plateau area of Colorado, but *R. hageni* and *R. undulata* have been. In any case, the presence of at least two species of the western sand/silt riverine faunal component (*H. solitaria* and *C. inornata*) at Capitol Reef clearly indicates that this area is within the geographic scope of this faunal pattern.

Those mayfly species that occur in both the Great Basin drainage system and the Colorado drainage system can be assumed to be Pluvial relicts in the Great Basin. The drainages were connected as recently as the late Pleistocene when some lakes of the Great Basin evidently overflowed into adjacent basins and did, for example, make contact with large rivers such as the Colorado (Blackwelder 1948).

While several southwestern collections of *C. inornata* have been reported by Kilgore and Allen (1973), no habitat or life history data were made available from these collections. In Colorado, B. C. Kondratieff (pers. comm.) has collected larvae of *C. inornata* only from coarse sand to gravel substrates in a wide variety of stream types (see also McCafferty *et al.* 1993); emergence of this species occurs in September. The few Utah individuals that were collected were taken from a small isolated channel of Pleasant Creek (see general description above) where it undercuts the north bank somewhat. Although the substrate there was mainly pebbles and small cobble, the larvae could have been kicked out of pockets of sandy gravel that were also present; we cannot say for certain. All individuals were middle instar larvae (early August), and suggest a late season (September) emergence, as has been observed for this species in Colorado (Kondratieff, pers. comm.). The collection date of the adults and subimagos of this species described by Eaton (1892) from Mexico and Arizona is not known.

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LITERATURE CITED

- Allen, R. K. 1974. *Neochoroterpes*, a new subgenus of *Choroterpes* Eaton from North America (Ephemeroptera: Leptophlebiidae). *Can. Entomol.* 106: 161-168.
- Bergman, A. E. and W. L. Hilsenhoff. 1978. *Baetis* (Ephemeroptera: Baetidae) of Wisconsin. *Gr. Lakes Entomol.* 11: 125-135.
- Blackwelder, E. 1948. The geological background. pp. 3-16 *In: The Great Basin with emphasis on glacial and postglacial times.* *Bull. Univ. Utah*, Vol. 38.
- Eaton, A. E. 1892. Fam. Ephemeridae. pp. 1-16 *In Biologia Centrali-Americana, Zoologia, Class Insecta, Order Neuroptera*, Vol. 38.
- Edmunds, G. F., Jr. 1952. Studies on Ephemeroptera. Part II. The taxonomy and biology of the mayflies of Utah. Unpubl. Ph.D. Thesis, Univ. Massachusetts.
- Edmunds, G. F. Jr. 1954. The mayflies of Utah. *Proc. Utah Acad. Sci. Arts Lett.* 31: 64-66.
- Flannagan, P. M. and J. F. Flannagan. 1982. Present distribution and post-glacial origin of the Ephemeroptera, Plecoptera, and Trichoptera of Manitoba. *Manitoba Dept. Nat. Res. Fish. Tech. Rep.* 81-82: 1-79.
- Gleason, H. A. and A. Cronquist. 1964. *The natural geography of plants.* Columbia Univ. Press, New York.
- Hubbs, C. L. and R. R. Miller. 1948. The zoological evidence. pp. 17-144 *In: The Great Basin with emphasis on glacial and postglacial times.* *Bull. Univ. Utah*, Vol. 38.
- Kilgore, J. I. and R. K. Allen. 1973. Mayflies of the Southwest: New species, descriptions, and records (Ephemeroptera). *Ann. Entomol. Soc. Am.* 66: 321-332.
- McCafferty, W. P. 1990. Biogeographic affinities of the Ephemeroptera of the Black Hills, South Dakota. *Entomol. News* 101: 193-199.
- McCafferty, W. P. and A. V. Provonsh. 1978. The Ephemeroptera of mountainous Arkansas. *J. Kans. Entomol. Soc.* 51: 360-379.
- McCafferty, W. P., R. S. Durfee, and B. C. Kondratieff. 1993. Colorado mayflies (Ephemeroptera): An annotated inventory. *Southwest. Nat.* 38: 252-274.
- Miller, R. R. 1958. Origin and affinities of the freshwater fish fauna of western North America. pp. 187-222 *In: C. L. Hubbs [ed.]. Zoogeography.* *Publ. Am. Assoc. Adv. Sci.*, 51.
- Morihara, D. K. and W. P. McCafferty. 1979. The *Baetis* larvae of North America (Ephemeroptera: Baetidae). *Trans. Am. Entomol. Soc.* 105: 139-221.
- Page, L. M. 1983. *Handbook of darters.* TFW Publ., Neptune City, New Jersey
- Ross, H. H. 1967. The evolution and past dispersal of the Trichoptera. *Annu. Rev. Entomol.* 12: 169-206.
- Ross, H. H., G. L. Rotramel, J. E. H. and J. F. McAlpine. 1967. Postglacial colonization of Canada by its subboreal winter stoneflies of the genus *Allocapnia*. *Can. Entomol.* 99: 703-712.
- Smith, C. L. 1983. Going with the flow. *Nat. Hist. March:* 48-57.